EFFECT OF PROCESSED SPENT BLEACHING EARTH AND KENAF FIBRE ON COMPRESSIVE STRENGTH AND DRYING SHRINKAGE OF FOAMED CONCRETE

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

Alhamdulillah, praise to Allah S.W.T. the Most Merciful and Most Gracious, peace and blessing upon the prophet Muhammad S.A.W. Thank you, Allah, for giving me strength and patience to complete this dissertation. Thank you for helping me and let me pass a hard time with ease.

I am very much grateful to Pn. Rokiah Binti Othman for her valuable guidance, keen interest and encouragement throughout my study. I thank her for letting me learn to be independent, but at the same time, she always ready to help me out when I am in need. Her guidance has made this a thoughtful and rewarding journey.

A special thanks dedicated to my beloved parents, En. Mahmood and Pn. Norma, as well as my family who always give motivation and continuous support that help me went through the hard times. Your love will forever hold dear in my heart.

Last but not least, thank you to all my friends for your support and patience. May Allah bless all of you throughout your journey.

ABSTRAK

Bahan Pozzolanic dihasilkan oleh pembakaran sisa dari bahan semula jadi atau tiruan. Dalam kajian ini, Processed Spent Bleaching Earth (PSBE) adalah produk dari kelapa sawit dan pelunturan minyak kelapa sawit mentah (CPO) dari minyak kelapa sawit halus yang lazimnya dilupuskan di tapak pelupusan sampingan dengan kos yang tinggi. Dalam kajian ini, PSBE digunakan sebagai pengganti simen separa kepada Semen Portland Biasa (OPC). Ini adalah tiga campuran yang disediakan iaitu konkrit berbuih (FC), konkrit berbuih dengan 30% PSBE (PFC) dan konkrit berbuih dengan 30% PSBE dan 0.5% kenaf fiber (PKC). Semua spesimen bersedia untuk menyiasat kekuatan mampatan, pengecutan, penurunan berat badan dan kedalaman pengkarbonan. Hasilnya untuk kekuatan mampatan, campuran mengandungi 30% PSBE sebagai pengganti simen separa menghasilkan tekanan mampatan tertinggi berbanding FC dan PKC. Selain itu, campuran kehadiran serat kenaf yang PKC menunjukkan pengecutan yang lebih rendah berbanding PFC dan FC. Di samping itu, hasil penguncupan pengecutan bagi hasil peratusan penurunan berat badan yang bermaksud PKC mempunyai peratusan penurunan berat badan yang lebih rendah berbanding PFC dan FC. Sementara itu, FC menghasilkan nilai tertinggi bagi kedalaman karbonasi dalam konkrit berbuih berbanding PFC dan PKC. Kajian ini membayangkan PSBE sebagai pengganti separa adalah baik dan bermanfaat, terutamanya untuk pengeluaran untuk konkrit berbuih.

ABSTRACT

Pozzolanic material produced by combustion of the waste from natural or artificial material. In this study, Processed Spent Bleaching Earth (PSBE) is a by-product from the degumming and bleaching of crude palm oil (CPO) from physically refined palm oil is commonly disposed of at landfills at a high cost. In this present study, PSBE used as partial cement replacement to Ordinary Portland Cement (OPC). These are three mixture has been prepared, namely foamed concrete (FC), foamed concrete with 30% PSBE (PFC) and foamed concrete with 30% PSBE and 0.5% kenaf fiber (PKC). All specimens were prepared to investigate the compressive strength, shrinkage, weight loss and carbonation depth. The result for compressive strength, the mixture contains 30% PSBE as partial cement replacement produced the highest compressive stress compared to FC and PKC. Other than that, the mixture that presence kenaf fiber, which is PKC, shows the lower shrinkage compared to PFC and FC. Besides that, the result for shrinkage influence for the result of the percentage of weight loss, which means the PKC have a lower percentage of weight loss compared to PFC and FC. Meanwhile, FC produced the highest value for the carbonation depth of foamed concrete compared to PFC and PKC. The study implies PSBE as partial replacement is useful and beneficial, especially for the production for foamed concrete.

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LIST OF SYMBOLS

%	Percentage
°C	Celcius
°F	Fahrenheit
µm	Micrometre

LIST OF ABBREVIATIONS

BC	Before Century
Sdn. Bhd.	Sendirian Berhad
SBE	Spent Bleaching Earth
PSBE	Processed Spent Bleaching Earth
OPC	Ordinary Portland Cement
ASTM	American Society for Testing and Materials
BS	British Standard
FC	Foamed Concrete
PFC	Foamed Concrete with PSBE
PKC	Foamed Concrete with PSBE and Kenaf Fibre
w/c	Water per cement
UMP	University Malaysia Pahang
CO_2	Carbon Dioxide
C_3S	Tricalcium Silicate
C_2S	Dicalcium Silicate
C_3A	Tricalcium Aluminate
C_4AH	Calcium Aluminate Hydrate
SiO_2	Silicon Dioxide
$CaCO_3$	Calcium Carbonate
$Ca(OH)_2$	Calcium Hydroxide
C-S-H	Calcium Silicate Hydrate
H_2O	Water
Al_2O_3	Aluminium Oxide
$C_{20}H_{14}O_4$	Phenolphthalein
mm	Millimeter
kg/m^3	Kilogram per meter cube
MPa	Mega Pascal
L	Litre
m^3	Meter cube
kg	Kilogram

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In the construction industry, concrete is essential because commonly used as a structural element. For example, slab, column and wall are produced by concrete because concrete is a durable building material. In Latin, concrete is called "concretus," which means to grow together. Concretus is the first name of concrete. Concrete made by mixing with different material such as fine aggregates and coarse aggregates which are sand and gravel and also mixing with water. Based on Roxanne Pepin, the earliest recordings of concrete structures by Nabataea traders in the regions of Syria and Jordan date back to 6500BC (previous century). They created concrete floors, build ings and underground cisterns. Concrete is excellent in strength and durability, but it is not good in term of weight.

The advance of technology of concrete, foamed concrete has introduced. Foamed concrete, also is known as lightweight concrete, aerated concrete and porous concrete. Foamed concrete made by mixing of cement, water and foam. Foamed concrete can be used for wide range application such as roof insulation, levelling floors, void filling and ground stabilisation. Its properties can be adjusted on demand by varying the amount of water, cement, sand and foam. Foamed concrete created when air voids in mortar entrapped by a suitable foaming agent. Moreover, foamed concrete with densities between 400 kg/m3 and 1600 kg/m3 obtained for structural, partition, insulation, and filling grades (Farzadnia et al., 2015). One of the advantages of foamed concrete is the concrete is lighter than normal concrete. Nowadays, foamed concrete is popular uses because of the low cost and efficiently to move from the factory to the site.

However, this foamed concrete also have disadvantages that effect the strength of the foamed concrete. A few testing were conducted in this research to study the strength of foamed concrete, drying shrinkage and carbonation. In these studies, the materials that used were kenaf fiber and Processed Spent Bleaching Earth (PSBE) as the partial cement replacement.

1.2 Problem Statement

In the 21st century, every country is developing rapidly and more construction is ongoing indirectly. Every time construction will be carried out, a new area or spacious area will be used to carry out construction activities, and forest exploration will take effect. Carbon dioxide gases freely spread in the atmosphere. Besides that, using normal concrete is standard things to the contractor to construct a building. Standard concrete also will produce gas carbon dioxide (CO_2); hence, these will cause the greenhouse effect. These gas is resulting from the chemical impact of the cement that mix with water. The more construction using normal concrete, the more gas CO_2 will be released. Increasing the concentration of atmospheric carbon dioxide, affect the carbonation of concrete structures will become serious (Aini, Sari, Rahim, & Sani, 2017). After that, damaging of the concrete will give a harmful effect to the structure that can make the concrete crack and will affect the strength of the concrete too. The most common factor that occurs concrete to crack is drying shrinkage. Drying shrinkage is defined as a contracting of concrete due to the loss of water while still in the plastic state. Next, the strength of the concrete will be affected and can cause the concrete to fail. Every structure must good in strength to construct a building for a long period. The low strength in concrete, it is easy for structure to collapse. Lastly, a normal concrete is much heavy because of the existing aggregates. Even though the aggregates are essential in the mixture of concrete, but it causes the concrete to be heavier. The high density of the concrete, the increasing of the structural dead loads. These may lead to an increase in the cost of the construction.

1.3 Objective

The goal of this study is to investigate the effect of kenaf as fiber and processed spent bleaching earth (PSBE) as cement partial replacement in foamed concrete. The objectives of this study are:

i. To determine the compressive strength of foamed concrete
ii. To determine the drying shrinkage of foamed concrete
iii. To determine the weight loss of foamed concrete
iv. To determine the carbonation of foamed concrete

1.4 Scope of Research

This study was done to determine the effect of kenaf as fiber and processed spent bleaching earth (PSBE) as partial replacement of cement in foamed concrete. The materials mixed according to ratio 30% of PSBE and 0.5% of kenaf fiber. All materials and specimen preparation based on ASTM and BS standard code practice requirement. For this research, there are four testings conducted using three types of the mixture with namely foamed concrete (FC), foamed concrete with 30% of PSBE (PFC), and foamed concrete with 0.5 % kenaf fiber and 30% of PSBE (KFC). In this study, the shrinkage, compressive strength, weight loss and carbonation were tested and evaluated. The prism beam with dimension 40mm x 40mm x 60mm used for shrinkage and weight loss as followed ASTM C157 / C157M – 17 Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete. The cube with dimension 150mm x 150mm x 150mm used for compressive strength and carbonation referred to ASTM C109 Standards Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

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